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WITH THE COMPLIMENTS OF THE AUTHOR.

A FATAL CASE OF POISONING

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ARSENIATE OF SODIUM.

[Reprint from the Medico-Legal Journal.]

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A FATAL CASE OF POISONING BY ARSENIATE OF SODIUM.*

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The case now presented is of more than usual interest from the remarkable character of the symptoms, which so completely simulated those of an alkaloid resembling belladonna, as to lead both the medical attendant and the chemist, at first, to the opinion that no metallic poison could be the cause of death. But the chemical examination detected only arsenic acid, and this in combination with sodium, in such large quantity, that there was no room to doubt that this was the fatal agent.

Before giving the medical testimony in this case it may be well to review, briefly, the state of our knowledge respecting the toxical history of arsenic acid and its compounds.

Poisoning by arsenic acid is very rare. Compared to arsenious acid, the familiar white arsenic, the too frequent toxical agent, arsenic acid is extremely rare. Orfila says: "The action of arsenic acid on the animal economy differs from the effects of arsenious acid only in being more energetic." † And again, the arseniates act on the animal economy like the other arsenical preparations. ‡ The history of the case in hand materially modifies this statement.

* Read before the Medico-Legal Society of New York, October 3, 1883.

† *Médecine Légale*, iii, 125, 1828. ‡ Ibid, 126.

Dr. Taylor says: "I have not been able to find any instance of poisoning by arsenic acid in the human subject."*

Dr. Christison does not mention arsenic acid as a poison, but cites two cases of accidental poisoning by arseniate of potassium, and also of the poisoning of seven horses by it at Paris.†

Messrs. Wharton and Stille ‡ cite two instances of poisoning by arseniate of sodium in France (1852): "Two young men sent to a chemist for doses of tartarate of sodium, in place of which arseniate of sodium was sent by mistake and taken. In about five minutes they were attacked with violent cramps in the stomach, which speedily became very intense. One died, and the other lingered in a dangerous state."

Dr. Taylor mentions § "an attempt at murder by the arseniate of potassium, which was the subject of a trial in France in 1844. This poisonous salt had been maliciously put into a bottle of wine. But a small portion was taken by the man, the bitter taste causing him to reject it. His wife also drank but a small quantity. Both suffered from severe colic, vomiting, great prostration of strength and stupor. A portion of the suspected wine was given to a dog, the animal suffered from violent vomiting and convulsions, and died in a few hours. Mr. Chavallier analyzed the wine and found about one drachm of arseniate of potassium in a pint"

DRAGENDORFF, p. 323, says: "Less important (but still noteworthy) than the poisoning by arsenious acid and its

* A Treatise on Poisons, Am. edition, 1875, 343.

† Treatise on Poisons, Edinburgh, 1845, 284. Also Annales de Hygiène Mèd. Legale, xii, 303.

‡ Medical Jurisprudence, 1855, 433.

§ Treatise on Poisons, loc. cit., 344.

combinations, are the salts and acid of arsenic acid employed in the preparation of analine dyes."

REESE, p. 251, says: "Arsenic acid is of no medico-legal interest."

WOODMAN and TIDY, p. 157, say: "There are no cases on record of poisoning with arsenic acid, in the free state in the human subject."

From these citations it will be observed that arsenic acid, as such, is not mentioned as having occasioned death, accidental or otherwise, but only its sodium and potassium salts.

Arsenic acid has been, until lately, of very rare occurrence, and seldom seen outside the chemist's laboratory. But since the introduction of analin colors arsenic acid has come largely into use as an agent for the oxydation of analin in the preparation of the supurb reds, magenta, etc. These brilliant colors frequently retain notable quantities of arsenic acid, and are it is said, never quite arsenic free, while in calico printing this agent is also used as a mordant in the form of arseniate of aluminium, and as a compound with albumen. It is also employed in wall papers in which arsenious acid and arsenite of copper have long been used.

Owing to these new uses arsenic acid is now prepared on a great scale in the arts by boiling white arsenic in a capacious tank with nitric acid of density 1.35 conducting the copious nitrous fumes, which carry a portion of arsenic, into towers filled with coke drenched with nitric acid, and evaporating the syrupy liquor, with agitation to a density of 15°. A semi-fluid mass results filled with transparent crystals of the hydrate of arsenic acid having the formula $As\ H_3\ O^4 + H_2\ O$. This hydrate is very soluble in water, producing

cold. The solid acid deliquesces in air, melts at 212° F., losing its crystallization water and forms then a mass of fine needles $As H^3 O^4$. It is intensely acid, and in its concentrated state attacks the skin, making blisters. Indeed it appears that those who are engaged in this manufacture and in the analin dye works suffer from cutaneous eruptions of a pustular kind, with œdema of the skin, colic, diarrhœa, vomiting, salivation, paralysis, and other symptoms showing an affection of the nervous system. The cutaneous eruptions are similar to those observed in workmen engaged in the manufacture of green arsenical wall papers.*

Arsenic acid has a disgusting metallic taste. Sulphydic acid produces in dilute solutions hardly a feeble coloration of the yellow sulphid. Reinsch's copper test fails to act as it does so promptly in arsenious acid solutions. Marsh's test acts with the greatest promptness owing to the fact that the nascent hydrogen reduces the arsenic acid to its lower state of oxydation in the arsenious acid. Argentic nitrate, in the absence of chlorine compounds, detects arsenic acid by the characteristic brick red arseniate, which appears even in presence of chlorides after the latter are first thrown down. Of all wet tests for arsenic acid the most delicate is the ammonium molybdate, which reacts with this as it does with phosphoric acid.

A new source of danger from arsenic acid is recently brought to public notice by the announcement from our consular agents in France that owing to the extensive destruction of vineyards by the ravages of phylloxera, in the Bordeaux districts especially, the manufacture of spurious red wines has been greatly extended, the coloring matter of which

* Charnet in *Ann. d'Hygiène*, 1863, ii., 281. Cited by Taylor, 344.

is derived chiefly from analin dyes, which, as already stated, are generally contaminated by arsenic employed as arsenic acid in the oxydation of analin. The risk arising from the use of the analin reds in coloring confectionery, liquors, vegetable syrups, vinegar, etc., has long been recognized.*

The ravages of the Colorado beetle or potato-bug (*Doryphora* 10-*lineata*, of Say), early led in the United States to the very general use of Paris green, or Scheele's green (the arsenite of copper), as an agent for destroying these pests. This compound of arsenious acid is usually diluted in powdered gypsum, and strewn over the foliage of the growing plant, or it is diffused in water and applied with a sprinkler. Grave fears were entertained at first lest the free use of this arsenical compound should lead to mischievous results, and this anxiety was increased by the expression of such an opinion in discussions before scientific societies. This led to an investigation, on the part of the United States Department of Agriculture, by the chemist Dr. McMurtrie, the results of which showed the groundless nature of these fears. The details of these experiments are recorded in the Commissioner's Report for 1875, pp. 144–147. It is clearly demonstrated by this investigation that plants do not absorb and assimilate arsenic, although when Paris green and arsenite and arseniate of potassium were used in sufficient quantity in the soil, the vitality of the plants, growing in the poisonous soil, was steadily impaired, as its quantity was decimally increased until life was destroyed. Dr. McMurtrie thus summarizes his results: "We must conclude that plants have not the power to absorb and assimilate from the soil compounds of arsenic, and that although arsenical com-

* See Taylor on Poisons, 1875, pp. 344, 345.

pounds exert an injurious influence upon vegetation, yet this is without effect until the quantity present reaches, for Paris green, about 900 pounds per acre; for arsenite of potassium, about 400 pounds per acre; and for arseniate of potassium, about 150 pounds per acre." *

"*Pest Poison.*"—Among the means proposed for the destruction of the Colorado beetle in 1876 was a preparation made in New York and sold under the name of "Pest Poison." It was to be dissolved in water, and the solution, very dilute, applied to the growing plant from a watering-pot. That it was an energetic poison was evident from the directions to use one pound or less in a barrel of water, but it does not appear that it was known or recognized as an arsenical compound, nor did the printed directions on the package contain any warning as to its dangerous character. As it came into my hands in November, 1876, it was a dry cake of a pink color, completely soluble in water with a decided alkaline reaction, and giving to sulphydric acid no sensible precipitate, and with Reinsch's copper test affording no arsenical coating. Hence its true nature, for the moment, eluded detection, especially as Dr. Huntington's clear account of the case appeared to favor the belief that this so-called Pest Poison was an alkaloid of the class of belladonna. So closely did the symptoms simulate those of a nervous poison as to mislead the judgment from the suspicion that we were dealing with a metallic irritant. This will appear more clearly when we read Dr. Samuel H. Huntington's statement, viz.:

"WEST HARTFORD, CONN., Nov. 16, 1876.

"PROF. SILLIMAN—DEAR SIR: It gives me pleasure to state,

* Department of Agriculture. Rep. from 1875, Washington, 1876, p. 147.

in compliance with your request, the symptoms observed in the case of poisoning that I mentioned to you last Friday. The patient was a boy aged between three and four years. He gained access to the poison by being carried to the field in June, where his father and others were engaged in exterminating potato-bugs with it. Being left to amuse himself he began playing with a package of the poison, and finding nothing disagreeable in its taste, ate an unknown quantity.

"The accident was first discovered at about half-past five P. M., which must have been within a quarter of an hour of the time of swallowing the poison. The child was found playing with the box containing the poison, and in answer to his father's inquiries said that he had taken some of the pink stuff and felt sick. He first complained of thirst and nausea, and retched slightly as though attempting to vomit, but he did not vomit, although his parents administered a considerable quantity of ipecac. These were the only signs of gastric irritation that were noticed, and they rapidly subsided, giving place to symptoms of a nervous type.

"I first saw the child at six o'clock, within half or three-quarters of an hour of the poisoning. He was then in a state of profound stupor, from which it was impossible for a long time to arouse him. Great muscular debility was manifest. The pupils were widely dilated. The pulse was very rapid—130 per minute—and small. The respiration hurried —50 to 60 per minute—and shallow.

"Active emetics, followed by diluent drinks, caused a free evacuation of the contents of the stomach. This vomiting was repeated at intervals during the evening, but only when induced by swallowing large quantities of liquids.

"The matters vomited were merely the substances swallowed, and did not contain any blood or much mucus.

"After emptying the stomach stimulants were given, and attempts were made by various irritating movements of the body to arouse the patient from the almost comatose state in which he lay. These attempts so far succeeded that at eight

in the evening both a physician for whom I had sent from Hartford, on seeing the dangerous condition of the child, and myself, thought the danger of death was passed. The symptoms which were so alarming were nearly all greatly ameliorated; the profound sleep had nearly passed away. The child answered readily when spoken to, would call for its playthings, and showed great anger when either himself or his pets were annoyed. The pupils were contracted to about the normal size. The pulse was much slower and fuller. Greater muscular strength was shown. The respiration was still hurried, but not so rapid or shallow as at first. This apparent improvement continued until after midnight.

"At about one A. M. all the indications of danger returned with redoubled force. The patient became comatose; the pulse rose to 130–140 beats per minute, and was very small; the respiration became 70 to 80 per minute, and extremely shallow; the surface of the body became pallid; the extremities cold and the lips blue; the pupils were again dilated; tracheal râles were heard, and death took place at about two fifteen in the morning, eight-and-three-quarter hours after the symptoms of poisoning were first observed, and probably about nine hours after swallowing the mischievous agent.

"All attempts to arouse the patient from his last relapse were entirely futile.

"The manner of death seemed to be by paralysis of the respiratory nerves; during the whole attack, in fact, the disturbance of respiration was one of the most noticeable symptoms. There were no signs of gastric irritation except the thirst and nausea during the first few minutes. There were no indications of disturbance of the intestines. The bowels were evacuated artificially by administering injections, but the substances voided were perfectly normal.

"*During the whole time no complaint whatever was made of pain!* No convulsions were noticed. * *

"I remain respectfully yours,

(Signed) "SAM'L H. HUNTINGTON."

In a subsequent communication, in reply to my inquiry, Dr. Huntington adds: "I regret that I am unable to give any information regarding changes produced by the poison in the body of my patient.

"Though I fully appreciated the importance of an autopsy in the case, I was unable to persuade the parents of the child to allow one to be made.

"The symptoms, however, were all referable to the nervous system. No indications of gastro-intestinal irritations were seen."

It is needless to say that nearly all, probably all the symptoms of this interesting case of arsenic acid poisoning are such that any medical man, judging from the physical signs alone, must say that they were neurotic and probably referable to a powerful alkaloid. Atropia, belladonna, stramonium, etc., etc., all find some of their characteristics simulated here. Even the delirium of stramonium, etc., might be considered as manifest in the sudden anger of the child. In fact, I see nothing in the entire train of symptoms, so well described by Dr. Huntington, which should offer even a suggestion that arsenic was the toxical agent in this case. Its indications were conspicuous only by their absence, and the evidence from the physical signs was certainly sufficient to throw one off the line of suspecting a metallic poison.

I searched for alkaloids in vain. The quantitative analysis showed neither chlorine nor sulphuric acid. Sulphydric acid produced no evidence of a heavy metal. The spectroscope gave no evidence of potassium. The sodium flame was very strong. Marsh's test disclosed the presence of arsenic abundantly, and argentic nitrate showed that it was present only as *arsenic-acid*. This sample of "pest poison," so

called—the same which killed Dr. Huntington's patient—was, therefore, *sodium-arseniate*, colored pink, as a disguise, by analin red. I have since seen this preparation colored blue, and heavily charged with sodium chloride, but having still arsenic, as arsenic-acid, in combination with sodium and aluminum. The blue color was probably Prussian blue, with a trace of copper.